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Minerals Health and Safety Contract Research, Development, and Demonstration In Fiscal Year 1980

By Staff, Division of Minerals Health and Safety Technology

UNITED STATES DEPARTMENT OF THE INTERIOR

United States. Bureau of Mines.

Information Circular 8816

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UNITED STATES DEPARTMENT OF THE INTERIOR
Cecil D. Andrus, Secretary

BUREAU OF MINES
Lindsay D. Norman, Acting Director

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MINERALS HEALTH AND SAFETY CONTRACT RESEARCH, DEVELOPMENT, AND DEMONSTRATION IN FISCAL YEAR 1980

by

Staff, Division of Minerals Health and Safety Technology

ABSTRACT

This publication summarizes, for potential contractors and other interested parties, the research, development, and demonstration contract projects programed by the Bureau of Mines for fiscal year 1980 (October 1, 1979 - September 30, 1980) under its Minerals Health and Safety Research program. The objective of these projects is to provide an ordered and sequenced series of advances toward the Bureau's overall goal of providing the system technology required to create a healthier and safer working environment for the Nation's mining and minerals processing workers.

INTRODUCTION

It is the policy of the Bureau of Mines to utilize as fully as possible the capabilities of the private sector in minerals research, and to that end this paper outlines the Bureau's present contract research needs to enable potential contractors to make decisions about participation in the program.

It is important to realize that since this is a summary document, the project descriptions related to a design, fabrication, and demonstration effort do not necessarily imply total package procurement. The projects presented here represent the plans conceived at the beginning of the fiscal year and are subject to change based on emerging priorities and the availability of funds. A companion publication, Information Circular 8817, lists in-house projects.

Contracting for the Minerals Health and Safety Research program will be conducted in strict accordance with Federal Procurement Regulations. Availability of requests for proposals (RFP's) will be formally advertised in the Commerce Business Daily. No additional information will be supplied on these projects until after the RFP's are made available and then only in strict accordance with prescribed procedures. This document is not intended to solicit proposals from the contracting community. All unsolicited proposals (USP's) whose content reflects the objective(s) of proposed projects listed herein will be returned without formal review.

PROGRAM OUTLINE

The objective of the Minerals Health and Safety Research program is to protect the health and safety of mining and minerals processing workers while insuring that newly developed technology incorporates health and safety criteria. In achieving this objective, four fundamental and complementary requirements must be considered by the research program, as follows:

1. Contributing to the viability of a basic industry.

2. Sustaining productivity.

3. Allowing for a return on capital investment.

4. Providing material and energy to the public.

Since mining and minerals processing involves a highly integrated and interrelated set of functions, the program has been divided into a set of interrelated subprograms, each with goals that will provide systems technology solutions to the problems within the framework of these fundamental requirements. The Minerals Health and Safety Research program is divided into 12 subprogram areas as shown:

Health	Safety
Respirable Dust	Fire and Explosion Prevention
Radiation Hazards	Methane Control
Noise Control	Ground Control
Industrial Hygiene	Industrial Hazards
Ventilation	Post-Disaster
	Explosives
	Systems Engineering

The following objectives of these subprograms are described in the following pages, followed by the planned projects and their corresponding descriptions. It is not possible to give exact dollar estimates by subprogram area for competitive reasons, but the aggregate value of the anticipated contracts is approximately $37 million.

HEALTH

Respirable Dust

Program Objectives: To develop procedures for controlling the respirable dusts that still constitute the severest health problem facing the mining and mineral processing industries. To develop and/or improve techniques and equipment to prevent formation of hazardous dust concentrations, and to protect miners against dusty atmospheres.

Fragmentation Control

1. Deep Cutting Double Arm Shearer

Objective: To reduce airborne dust on longwall panel by development of a deep cutting longwall shearer with a wider web. A deep cutting longwall shearer will be designed, constructed, and tested in an underground coal mine. The design criteria will be taken from the results of contracts H0122039 "Deep Cutting Continuous Miner" and J0177019 "Deep Cutting Miner Production Tests," both with Ingersoll-Rand, and the results of other Bureau and industry research. This is a continuation of an ongoing effort.

2. Effect of Continuous Mining Machine Operator Variables on Dust Generation During Coal Cutting

Objective: To determine what effect a mining machine operator has on the generation of respirable dust. The contractor shall perform only as much operating analysis as is necessary to define those operator variables during continuous mining machine use which contribute to primary dust generation. The level of operator control over each factor contributing to primary dust generation shall be determined. The contractor shall determine which operator variables are controllable and which are not. This is a new RFP.

3. Rotary Seal Development for Continuous Mining Machines

Objective: To develop and demonstrate a long-life rotary water seal suitable to the mining environment and compatible with continuous mining machines to control airborne respirable dust and methane ignition potential. Sealing force, face deformation, and frictional heating in the dynamic mode shall be evaluated for leakage rates and time to failure. A life test machine shall be fabricated to simulate field test. This is a new RFP.

4. Basic Research on Coal Fragmentation and Dust Entrainment

Objective: To develop long-term, multidisciplinary plan-of-action to determine basic causes of dust entrainment from bit contact. A detailed background literature investigation shall be performed prior to development of a research approach. This is a new RFP.

Control of Generated Dust

5. In-Mine Tests for Wetting Agents Effectiveness

Objective: To conduct dust sampling surveys in 10 underground sections along coal haulage roadways to determine the long- and short-range effects on roadways through the use of wetting agents. This is a continuation of an ongoing effort.

6. Shearer-Mounted Dust Collector

Objective: To redesign a current model of a double-drum longwall shearer to incorporate a nominal 10,000-cfm scrubber system into the main body of the shearer or a 5,000-cfm scrubber system into each ranging arm. The system shall be designed to not degrade the productivity of the shearer. The dust collector is expected to be a flooded fibrous-bed type. This is a continuation of a ongoing effort.

7. Evaluate Longwall Dust Sources and Control Technology

Objective: To determine the sources of respirable dust on a double-ended ranging drum shearer longwall panel by isolating as much as possible each of the sources to establish the level of relative influence. After identifying and quantifying dust sources, the contractor shall set up a longwall operation optimizing all existing dust control technology and establish the lowest dust level that existing technology will give. This is a new RFP.

8. Dust Control for Roof Drills

Objective: To develop and test an improved cutting removal system for roof drills that will prevent the entrainment of dust particles in the mine ventilation air. This is a new RFP.

9. Demonstration of a Boom-Mounted Scrubber

Objective: To fabricate and perform underground tests of a new boom-mounted twin scrubber arrangement incorporating two, small, 2,500-cfm scrubbers into the auger support frame of a continuous miner. The effectiveness of this system in removing respirable dust from the face area and the miner's workplaces will be evaluated. This is a continuation of an ongoing effort.

Personal Protection

10. Improved Canopy Air Curtain Systems

Objective: To study the current canopy air curtain design, improve the efficiency and user acceptance of the system, and apply the concept to a greater variety of mine uses. The contractor shall evaluate 10 operable

canopy air curtains at a minimum of five mine locations and determine what dust reductions are achieved at the operator by each curtain. Upon completion of the evaluation, the contractor shall redesign the existing system to incorporate features that will substantially improve the overall efficiency of the system. This is a new RFP.

11. Dry Dust Collectors

Objective: To design, fabricate, and demonstrate a small, safe, simple, and rugged dry collector that will be suitable for machine mounting, belt transfer, and other mining applications. The contractor shall fabricate and test two collectors. The collectors shall be tested in a coal and trona mine for a period of 3 months. This is a continuation of an ongoing effort.

12. Ventilation System for Bag Handlers in Enclosed Vehicles

Objective: To design, fabricate, and demonstrate the most efficient ventilation system for enclosed rail cars and trucks for the purpose of reducing bag handlers' exposure to dust. The system shall be a filtered blowing type incorporating a restriction indicator that consists of a warning light and a heater capable of raising the temperature from 20° F to at least 50° F; it should be deployed easily with little effort on the part of the worker. This is a new RFP.

13. Hollow and Wet Cutter Bars

Objective: To develop, design, and demonstrate (1) a hollow cutter bar incorporated into a dust collection system and (2) a wet cutter bar for dust suppression. The spray nozzles in the wet cutter bar shall be selected to optimize dust reduction efficiency and provide a minimum working pressure and water consumption. This is a new RFP.

14. Conveyor Belt Dust Control

Objective: To reduce the occurrence of respirable dust at conveyor belt loading, dumping, and transfer points by developing a suppression/collection system. Data gathering and analysis of all presently available dust control technologies shall be performed. The selected system(s) shall be redesigned, if necessary, to achieve optimum performance. This is a new RFP.

15. Evaluation of Charged Water Sprays

Objective: To investigate the feasibility of controlling respirable dust in noncoal mines with a mist and/or spray of the opposite charge, thereby promoting enhanced contact between the particulates and charged droplets, rapid agglomeration, and fallout of the wetted particulates. The contractor will conduct a literature study, construct a charged spray, a mist device, and conduct a demonstration in an underground mine. This is a new RFP.

16. Survey of Dust Control Technology

Objective: To conduct a survey of crushed stone, sand and gravel, gypsum, asbestos, cement and talc operations and identify the type and frequency of the dust problems in such areas as overburden removal, loading, transfer and conveying, crushing, truck dumping and haulroads between similar and dissimilar operations. Assess the extent of respirable dust control in use by description through visual sightings and personal conversations. This is a new RFP.

Analytical Techniques and Equipment

17. Prototype Ionization Type Respirable Dust Measuring Instrument

Objective: To design, fabricate, and laboratory and field test a prototype respirable dust measuring instrument that uses ion attachment as the measurement technique and that can be used to assess the potential of the ion attachment technology for personal exposure monitors, portable direct indicating dust detectors, and machine-mounted respirable dust monitors. This is a new RFP.

18. Photometer Machine-Mounted Respirable Dust Monitor Development

Objective: To develop, design, and field test a respirable dust monitor employing a light-scattering sensor that can be mounted on a mining machine near the vicinity of the operator and will give the operator a visual signal of the immediate environmental dust level. The visual signal should be responsive to three ranges in dust concentrations: less than 2.0 mg/m^3, 2-3 mg/m^3, and greater than 8 mg/m^3. The unit shall provide audio and visual signals when the shift cumulative concentration exceeds 2.0 mg/m^3. The device shall be capable of storing the cumulative concentration for 10 shifts of operation on a plug-in module. Once removed, the module shall be capable of retaining the stored information for up to 5 days. The device shall be no larger than 6 in. x 6 in. x 10 in. This is a new RFP.

19. Evaluation of Dust Measuring Instruments

Objective: To conduct laboratory evaluation of dust measurement instruments to determine precision and accuracy for representative mine aerosols. Instruments to be considered include those that are commercially available and those developed by Bureau contractors. A list of instruments to be evaluated will be prepared for approval by USBM and MSHA prior to lab evaluations. This is a continuation of an ongoing effort.

20. Direct Indicating Personal Exposure Monitor

Objective: To develop a reliable, accurate, direct-indicating, personal exposure monitor for respirable dust. The device shall provide for timely feedback of dust exposure information to the wearer and other mine personnel, thus allowing for timely assessment of the effectiveness of dust control hardware, work practices, and ventilation systems for respirable dust exposure reduction. This is a new RFP.

21. Design and Evaluation of Dust Monitoring Programs

Objective: To evaluate dust monitoring programs currently in use or under development as they apply to the mining industry, and to design comprehensive, cost-effective, rational dust monitoring programs for enforcement of current and possible new dust standards. The contractor shall analyze the available data and estimate the cost effectiveness of the most promising monitoring programs as well as recommend the optimum monitoring program. This is a new RFP.

22. Methods for Mineral Fiber Sample Evaluation

Objective: To develop a means of mineral fiber counting and minerological identification that is fast, reproducible, and specific enough to be used by MSHA for enforcement of standards. The contractor shall contact experts within and outside the Federal Government who are knowledgable in the area of electron microscopy and related optical fields to gather infromation necessary for development of appropriate counting and identification instruments, measurement methods, and procedures. This is a new RFP.

23. Field Instrument for Quartz Analysis

Objective: To develop, fabricate, and test an accurate and reliable portable device capable of rapidly measuring quartz (within 5 minutes) to $\pm$10 percent accuracy at the 50-microgram level, on field dust collection filters currently used by MSHA. This is a new RFP.

Radiation Hazards

Program Objective: To develop and provide new and improved radiation instrumentation, measurement, and control technology for protection of miners from exposure to radon and radon daughters and other nuclear radiation hazards in uranium and other mines.

Control of Radiation Hazards

1. Characterize Uranium Mine Atmospheres and Determine Major Radon Sources From Intake to Exhaust

Objective: To obtain valid, complete, accurate information on the atmospheric environment in active underground uranium mines, including: the size range and attachment characteristics of radon daughter aerosols; the size and concentration ranges or organic and inorganic particulates; radon and radon daughter working level profiles; temperature, humidity and pressure ranges and variations, and the influence of these factors on radon daughter aerosol behavior. In addition, isolate, identify, and measure the major natural and people-induced influences on radon emanation in uranium mines and determine major sources of radon from intake to exhaust. This is a new RFP.

2. Design and Field Evaluation of Bulkheads to Reduce Radon Leakage From Worked-Out Areas

Objective: To design, test, and evaluate four bulkhead configurations and determine the most effective design, construction technique, and use of construction materials to reduce radon leakage into the ventilation system of a uranium mine. The following control methods shall be evaluated for each bulkhead design: 1) reduced pressure behind the bulkhead, 2) measure behind the bulkhead at quasiequilibrium with the surface through an exhaust pipe, and 3) better sealant materials. In addition, the most effective location for construction of these bulkheads (placement criteria) in the worked-out areas shall be determined. A cost-effectiveness analysis of each bulkhead design shall be performed and a "how-to" handbook on the various designs shall be prepared. This is a new RFP.

Radiation Instrumentation and Measurement

3. Passive Track Etch Dosimeter

Objective: To support the ongoing dosimeter field study by fabricating and making ready required number of dosimeters, reading out exposed devices, analyzing data, and conducting problem analysis. Also, make necessary improvements and modifications to the track etch dosimeter based on performance during field test. Procedures for proper handling, maintenance, and readout shall be established. Current readout techniques shall be optimized to insure rapid and accurate readout, and specific readout equipment shall be recommended. This is a continuation of an ongoing effort.

4. Continuous Working Level Detector System

Objective: To design and fabricate in a single package, one continuous working level detector system using technology developed in the Bureau's radiation hazards research program. The monitor will include necessary electronics for transmitting signals via appropriate cables to a central data acquisition unit, with primary power being supplied by interconnecting cable. Costing of the prototype and typical production unit shall be performed. Development of a commercial source for this system is the ultimate goal. This is a new RFP.

Noise Control

Program Objectives: To identify noise sources in underground and surface mines and in related minerals processing surface facilities, to abate these noise sources through both field retrofit and factory redesign approaches so that the mining operations and minerals processing activities meet the Federal noise exposure standards, to provide more accurate measurement and instrumentation of the noise environment, and to provide industry with the technical knowledge necessary to select, design, and implement noise control measures.

1. Preparation Plant Design for Quiet Operation

Objective: To demonstrate state-of-the-art noise control technology for preparation plants by redesign rather than by retrofit techniques. This effort is a cooperative agreement with a preparation plant designer and constructor, a noise control consultant, and the Bureau. Acoustical consultants will work with the builder during the design phase to specify and select equipment, processes, and techniques that will result in a facility that complies with the Federal noise regulations. This is a continuation of an effort initiated in FY 1979.

2. Investigation and Control of Noise Generated During Coal Cutting

Objective: To develop practical methods of abating the airborne noise generated by the cutting and extration of coal by current and next-generation mining machines. The airborne noise generated during cutting and extraction will be investigated by laboratory experimental techniques as well as by actual in situ tests. A generalized noise prediction model will be developed to identify and evaluate noise control modifications and redesigns for cutting and extraction devices. Hardware shall be developed to determine the effectiveness of the changes. This is a continuation of an ongoing effort that has completed the laboratory testing phase.

3. Flammability Criteria for Noise Control Products Used in Underground Mines and in Confined Areas of Mineral Processing Plants

Objective: To develop practical and safe flammability criteria and guidelines for the use of acoustic materials in the minerals industry. The acoustic materials used in underground mines will be categorized, and the quantity and mounting configurations of materials necessary to noise control of

specific mine-machine systems by assessing available noise control technology will be determined. Using this information with existing flammability information, an overall hazard potential will be determined. This is a continuation of an ongoing effort.

4. Noise Study of Longwall Mining Systems

Objective: To develop quieter longwall mining equipment. The noise problems of longwall systems shall be identified, and feasible engineering controls that achieve quieter operation without affecting production shall be assessed and demonstrated. It is anticipated that the demonstration phase will involve a cooperative effort with a longwall equipment manufacturer. The identification and assessment phases were initiated in FY 1979.

5. Current Levels of Whole Body Vibrations in Mines

Objective: To determine and assess the present levels of mine personnel exposure to whole body vibrations and to compare these levels to the results of a medical literature search relating vibration parameters to physiological effects. This study represents the initial background effort in the possible establishment of a program in this area. This effort was initiated in FY 1979.

6. Development of Quiet Resilient Screens for Use in Coal Preparation

Objective: To develop quiet resilient decks for coal screening and to demonstrate their durability, maintenance considerations, acoustical effectiveness, and costs under long-term production conditions. Operational constraints to be investigated include wear and separation problems, blinding, material accumulation, and interference with production. This is a continuation of an ongoing effort.

7. Environmental Testing of Personal Audiodosimeters

Objective: To develop an American National Standard's Institute (ANSI) standard that will specify environmental requirements for audiodosimeters. Commercially available audiodosimeters will be environmentally tested under various conditions of temperature, humidity, dust, and vibration to determine their accuracy and durability. These tests will be performed in cooperation with the ANSI Audiodosimeter Group. This is a new RFP.

8. Noise Control Guidelines for the Coal Mining Industry--Handbook

Objective: To develop a noise control handbook for the coal mining industry. The handbook will be in two volumes. Volume I will provide general noise control techniques applicable to mining machinery. Volume II will give detailed examples of mining machinery that has been successfully noise controlled. This is a new RFP.

9. Demonstration of Noise Control of Surface Mobile Equipment

Objective: To demonstrate that mine operators can successfully abate excessive noise from mobile surface equipment by utilization of available acoustic technology. This effort will be a cost-sharing agreement with a

mining company. The mine operator shall serve as the prime contractor, providing mining machinery experience, and shall be complemented by an acoustical consultant. Equipment to be considered includes dozers, front-end loaders, trucks, and scrapers. This is a new RFP.

10. Abatement of Noise of Continuous Miners

Objective: To develop and demonstrate both retrofit and design noise control measures on two continuous-mining machines. Participation of the contractor with equipment manufacturers and mine operators is necessary. Emphasis is to be placed on the test and demonstration of the noise control measures in the mining environment. This is a continuation of an ongoing effort.

11. Machine Design Concepts for Noise Control

Objective: To influence the next generation mining equipment by identifying, evaluating, and providing applicable machine design concepts to the industry that will result in the development of low-noise emission products. Noise control techniques are to be addressed on a design basis and cover the entire scope of noise generating and radiating mechanisms. This is a continuation of an effort initiated in FY 1979.

12. Abatement of Taconite Plant Noise Sources

Objective: To develop and demonstrate practical engineering noise controls for equipment used in taconite plants. Prior work in this area determined the noise sources in taconite plants and concentrated on secondary crushers. This effort shall be aimed at quieting screens, rodmills, autogenous and semiautogenous mills, pneumatic rappers, and vacuum disk filters. Solutions developed shall be implemented in selected plants and evaluated to assess acoustic effectiveness, durability, and costs. This is a continuation of an ongoing effort.

13. Retrofit of Underground Load-Haul-Dump Machines With Noise Control Packages

Objective: To develop retrofit noise control technology for specific models of LHD machines. Noise control techniques shall be implemented and in-mine tested. Participation of the contractor with equipment manufacturers and mine operators is considered essential in conducting this contract. This contract is a continuation of ongoing efforts to quiet LHD's through retrofit means.

14. Vibrating Screen Noise Abatement

Objective: To field test and evaluate a prototype noise-abated, low head, sizing screen used in metal and nonmetal minerals processing. The screen will be installed in a processing plant and tested under actual production conditions to evaluate noise, screening performance, and durability. This is a continuation of an ongoing effort.

15. Application of Quiet Stoper Drill Technology to the Redesign of Jumbo Drills

Objective: To develop a quiet, jumbo-mounted drill through redesign techniques rather than through retrofit methods. The study shall involve noise control of both the drill body and the drill steel. Cooperation of a drill manufacturer is considered essential, since manufacturing expertise is required, and the final prototype drill shall be field-tested to assess its long-term noise level, drilling efficiency, and other operational parameters. This is a continuation of an ongoing effort.

16. Noise Control of Channel Burners

Objective: To determine if a new technique in quarrying using channel burners is feasible and practical. The new technique offers advantages in noise and dust control and involves remote drilling of rows of holes. This is a continuation of an ongoing project.

17. Factory Integration of Noise Control Techniques Into the Design of Portable Nonmetallic Mineral Processing Plants

Objective: To implement, at the factory level, noise control techniques into the design of portable nonmetallic minerals processing plants. An effort was initiated in FY 1979 to develop through retrofit techniques and to demonstrate noise control techniques on equipment used in crushing and screening such nonmetallic minerals as sand and gravel, crushed stone, cement, lime, and lightweight aggregates. Portable as well as stationary plants are being investigated. This proposed FY 1980 effort will be initiated following the completion of the FY 1979 effort.

Industrial Hygiene

Program Objective: To identify and control the health hazards created in underground mine and in mineral processing plants by toxic gases and fumes, and by certain particulates produced by explosives and combustibles and by diesel engines. To develop new instrumentation for monitoring toxic components of the underground environment and evaluate commercially available instrumentation. To develop and/or refine analytical techniques for characterizing and measuring toxic components, and to investigate methods for controlling the formation and accumulation of toxic products.

Toxic Gases and Materials

1. Toxic Fumes From Explosives Tested in an Underground Mine

Objective: To measure the toxic fumes developed by explosives at the working faces in mines. The contractor shall measure the toxic fumes developed by commercial explosives. Dynamite, water gel explosives, and ammonium nitrate-fuel oil shall be investigated in detail under various mining situations. The data shall be developed to supplement in-house data obtained in Bruceton, Pa., to help in the development of new Federal standards for toxic fumes from explosives. This is a continuation of an ongoing effort.

2. Development of a Mine Air Contaminant Measurement Program - Diesels and Explosives

Objective: Overall objective is to establish a strategy that will define mine air contaminant detection and sampling procedures. Specific goals are to provide MSHA with an airborne contaminant sampling program for enforcement of regulations, for adoption as policy or regulation, and for prevention of worker overexposure. Optimum and alternative detection and measurement devices or methods will be established for the regulated substances, and areas needing development will be identified. This effort was initiated in FY 1979.

3. Development of Direct Indicating Toxic Gas Detectors

Objective: To provide MSHA and the coal mining industry with personal direct-indicating detectors for toxic gases including CO, CO_2, NO, NO_2, CH_4, and O_2 for air sampling programs required to prevent personnel overexposure. Efforts involving CO and NO detectors will involve field-testing existing units. Second generation, hand-held, direct-indicating CO_2 and CH_4 detectors using infrared absorption techniques will be developed. Investigation of CO_2 detectors using conductivity techniques will be continued. Development of a direct-indicating colorimetric dosimeter for NO_2 detection will be initiated. Trade-off considerations of stationary monitors versus personal exposure monitors versus machine-mounted monitors for each specific gas detection program will be investigated. This is a multicontract program that involves continuation of ongoing efforts as well as new RFP's as required.

4. Identification of Airborne Contaminants in Oil Shale Mines

Objective: To identify what contaminants (primarily airborne) occurring in underground or enclosed oil shale operations require continual sampling for worker protection and/or enforcement on the basis of either a health, explosion, or fire hazard; and to identify the applicable sampling strategy

and methodology. This effort involves the study of oil shale operations, field survey investigations, and establishment of appropriate contaminant sampling/analytical methods. This is a new RFP.

5. Evaluation of Industrial Hygiene Instrumentation and Equipment

Objective: To evaluate commercial instrumentation applicable to the mining and minerals processing environment so that a high degree of confidence can be placed in the instrument's sampling and recording techniques. Performance criteria will be established for the instrumentation selected. Efforts will include evaluation of items as portability, ruggedness, completeness of instruction manuals, ease of calibration, instrinsic safety, and urgency of the requirement. Operational parameters to be evaluated will include items as accuracy, precision, response time, zero drift, span drift, calibration stability, interferences from other equipment, and environmental effects such as temperature, humidity, and dust. This is a new RFP.

Diesels

6. Development of Sampling and Analytical Methods for Toxicants in Diesel Exhaust Streams

Objective: To devise new and update analytical methods to sample diesel exhaust toxicants with emphasis on oxides of nitrogen, acroloein/formaldehyde, and sulfates. Laboratory and onsite tests on field-collected samples shall be conducted using state-of-the-art procedures. Improvements made in sampling methodology will help to improve credibility for test results obtained under the adverse conditions of the mine environment. This is a continuation of an ongoing effort.

7. Development and Utilization of the Stirling Engine for Powering Underground Mining Equipment

Objective: To ultimately demonstrate that a Stirling engine can be used to power underground mining machinery within acceptable emission levels. The initial efforts will assess the engine's emission levels using an engine dynamometer and a simulated power duty cycle. The measurements shall be made on an existing engine so that design changes can be made directly to the engine. Future efforts will assess the design changes required to make the Stirling engine an underground power source. This shall include projected ventilation requirements. This is a continuation of an ongoing effort.

8. Control of Diesel Exhaust in Mines and Confined Areas of Minerals Processing Plants

Objective: To design a control system for removal of at least 90 percent of the particulates from diesel-engine exhausts. The system shall be tested in tandem with control devices for removal of other pollutants. The other control devices include scrubbers, filters, and catalytic converters. The efficiency of pollutant removal shall be measured. The system should lower all contaminant levels below MSHA standards. This is a new RFP.

9. Investigate Nature of Diesel Particulates as a Function of Time and Immediate Environment

Objective: To study the formation and nature of diesel-engine particulates starting from their emission and continuing after dilution of the particulates as the exhaust gases are mixed with the mine atmosphere. The effort will involve determining particle size and state of aggregation of diesel particulates in real time, and studying absorption of polynuclear aromatic hydrocarbons, NO_x, and other chemically active or bioactive contaminants under controlled and uncontrolled conditions. This is a new RFP.

10. Survey of Diesel Powered Equipment in Underground Metal and Nonmetal Mines

Objective: To perform a detailed survey to characterize the diesel-powered equipment population in underground metal and nonmetal mining operations. This survey will make use of previous equipment studies made by the Bureau, both in-house and by contract. The effort also will require coordination with other Federal agencies as MSHA, NIOSH, EPA, and DOD as well as with mining equipment manufacturers and mine operators. This is a new RFP.

11. Relationship of Underground Diesel-Engine Maintenance to Emissions

Objective: To establish the relationship between specific diesel-powered equipment conditions and maintenance precedures to the levels of toxic exhaust emissions. Maintenance and emission monitoring of diesel-powered equipment is required to analyze maintenance practices and equipment history for features that can be correlated with engine performance. Also, in determining engine overhaul efficiency, emissions measurements will be made on rebuilt engines and comparisons made with manufacturer's new equipment specifications. This is a continuation of an ongoing effort.

Ventilation

Program Objectives: To develop ventilation systems required to maintain a safe and healthful atmosphere conducive to efficient work output in noncoal mines.

1. Testing Jet Fans in Metal/Nonmetal Mines With Large Cross-Sectional Airways

Objective: To evaluate and improve the performance of jet fans for (1) ventilating dead-ended working headings; (2) ventilating face areas, and (3) moving and mixing air in airways. Testing shall be conducted in noncoal mines having cross-sectional areas greater than 100 ft^2, with some greater than or equal to 900 ft^2. This is a new RFP.

2. Build and Test Analog Device for Simulation of Hardrock Mine Ventilation

Objective: To design and build an analog device to simulate hardrock mine ventilation. The system shall offer fewer obstacles in terms of personnel cost and availability. It shall be simple enough that personnel using it need not have any training or experience with computers. The proposed analog system shall be set up and tested at one hardrock mine. This is a new RFP.

3. Reverse Performance Characteristics of Main Mine Fans

Objective: To determine the reverse operation characteristic curves for some common types of main mine fans. Lab studies of two different types of axial flow main mine fans to obtain performance curves shall be conducted. In addition, flow measurements of a minimum of eight fans before and after reversal shall be performed in the field. This is a new RFP.

SAFETY

Fire and Explosion Prevention

Program Objectives: To reduce the potential for fires and explosions in mineral extraction and minerals processing operations; to minimize the danger to people on account of fires and explosions that do occur.

Ignition Research

1. Explosion Hazards From Heating and Sparking of Brake Linings on Mine Equipment

Objective: To determine the hazard of methane and/or coal dust ignition

from overheated or sparking brake lining materials. A facility will be built to carry out full-scale tests on brake lining material used currently or proposed for use on mining equipment. This is a new RFP.

Flame Propagation

2. Evaluation of the Construction of Fire Doors, Air Doors, and Bulkheads in Noncoal Mines

Objective: To design, fabricate, and test, in a mine, reliable fire doors, air doors, and bulkheads for use in large (12 x 12 feet or greater) openings in noncoal mines. To develop economical, practical, and reliable methods for remotely operating fire doors. This is a continuation of an ongoing effort.

3. Experimental Investigation of Mine Shaft Fires

Objective: To develop fire safety measures for prevention, suppression, and extinguishment of mine shaft fires. Fire trials in vertical ducts will be conducted to determine fire spread as a function of ignition intensity, ventilation air velocity, lining material, and their loading density. Extinguishing systems and agents will be tested to determine optimum techiques for extinguishment of shaft fires. This is a cooperative effort between the Bureau of Mines and Factory Mutual Corp.

4. Emergency Mine Escape and Rescue Routes by Video Display Based on Mine Fire Ventilation

Objective: To develop a computer code that will give a video display of safe escape and rescue routes in the event of a mine fire. The mine fire/ventilation code developed earlier, under a Bureau contract, will be adapted for use with existing computer hardware and interfaced with a video graphics terminal. Fire scenarios will be devised to develop and test the utility of the system. Instruction seminars will be developed and conducted to transfer the operation to MSHA and the minerals processing industry. This is a new RFP.

5. Precalculation of the Effect of Fires on Ventilation

Objective: To calculate, in advance of their occurence, the effect of transient fires on airflows, temperature, and mine atmosphere contamination in real mine ventilation networks. Results will be used to predict high danger zones, best escape and rescue routes, and optional firefighting procedures. This is a continuation of an ongoing effort.

6. Fluid Dynamics of Methane Roof Layers

Objective: To develop a system for measuring the turbulence, mean

velocity, and concentration in methane roof layers. The system will be developed for use in the Bureau's Experimental Mine. This is a continuation of an ongoing effort.

Fire Detection and Alarms

7. In-Mine Evaluation of Selective Submicron Particulate Fire Detectors

Objective: To evaluate selective submicron particulate detectors in an underground metal mine. Prototype detectors, developed under an existing contract, will be installed to monitor exhaust ventilation. Reliability, false alarm rates, sensitivity to background aerosols, and maintenance requirements will be evaluated. An incipient fire will be simulated and monitored. This is a continuation of an ongoing effort.

8. Analysis of Fire Safety Tests and Standards

Objective: To provide an analysis of fire safety tests and to provide appropriate information for an MSHA standards-promulgation effort. This project is in support of a parallel effort being conducted by the National Bureau of Standards for MSHA. This is a continuation of an ongoing effort.

9. A Pneumatic Fire Detection System for Underground Conveyor Belt Haulageways

Objective: To design, fabricate, install, and test a pneumatic fire detection system along a conveyor belt haulageway. A multipoint tube bundle network and a prototype particulate detector will be installed in a coal mine belt haulageway and tested for reliability. This is a continuation of an ongoing effort.

Suppression and Extinguishment

10. Gallery Testing Related to Mine Timber Fires

Objective: To operate a large-scale fire gallery for evaluating the relative effectiveness of fire safety measures proposed for use in metal and nonmetal mines and recommend improvements in mine safety based on results of fire trials. Fire trial results will be used to designate maximum untreated or treated timber loading densities in various areas and recommendations will be made for design and construction of bulkheads. The safe distance of a combustible ventilation door from a fire will be determined. This is a continuation of an ongoing effort.

11. Improved Fire Protection for Underground Fueling Areas

Objective: To evaluate the reliability and cost-effectiveness of various types of improved fire protection hardware for underground areas in mines. Prototype hardware, developed previously will be in-mine tested. A system designed for permanent fuel transfer points will be installed and

tested for at least 12 months. This is a continuation of an ongoing effort.

12. Develop and Fabricate a Prototype Inert Gas Generator for Extinguishment of Mine Fires

Objective: To develop a prototype inert gas generator that will deliver at least 3,000 cfm of inert gas containing a maximum of 2 percent oxygen. The contractor will be expected to assemble a jet engine, an afterburner. and a water spray coolant section that could be used for demonstration purposes in the Bruceton Experimental Mine. The assembly must be readily disassembled and transported to the scene of an accidental mine fire. This is a new RFP.

13. Field Survey of Float Dust in Coal Mining Operations

Objective: To survey, in 15 operating coal mines, the float dust content of dust deposits. Deposited dust samples will be taken using specified sampling techniques. The samples will be taken at specific locations and will be quantitatively analyzed for moisture, rock dust, shale, and other incombustibles. This is a continuation of an ongoing effort.

14. Improved Underground Welding and Cutting Fire Protection

Objective: To reduce the incidence of underground mine fires by increasing welding and cutting safety. Based on data collected by visits to selected mines and industrial firms, the contractor will determine underground mine welding and cutting fire hazards and current fire safety practice. Analysis will include improved torch designs, improved fluxes, fume protection, spark catchers, and wire mesh cages. Guidelines for mitigating the shortcoming of existing practices will be prepared. A manual explaining and summarizing these guidelines will be prepared. This is a new RFP.

15. Fireproof Structures or Areas for Housing Underground Electrical Installations

Objective: To develop structural and fireproof guidelines for electrical equipment installations that meet current regulation requirements. Fixed and temporary structural electrical enclosures will be defined. Guidelines for fireproofing or fire protecting each type of structure will be developed. Guidelines will also be developed for non-enclosed electrical installation areas. This is a new RFP.

16. Coal Dust Explosion Hazards in Surface Facilities

Objective: To define the hazards of coal dust explosions in surface coal handling facilities. The contractor will survey fire/explosion experience from 1965 to date in aboveground U.S. coal handling facilities. Emphasis will be given to pneumatic transport facilities and fluidized-bed coal dryers. This is a new RFP.

17. Poisoning of Catalytic Methane Sensors

Objective: To determine which chemicals will poison catalytic methane sensors that could be used in mines and develop techniques to prevent poisoning of commercial methane detectors that use catalytic sensors. Hydraulic fluids, belt dressings, paints, and other materials commonly used in coal mines will be examined for volatile components that poison methane sensors. Techniques for protecting methane sensors will be developed and tested in coal mines. This is a new RFP.

18. Infrared Methane Monitor

Objective: To carry on prior years' development of an infrared methane monitor. Methane monitors placed underground will be evaluated for reliability and accuracy. This is a continuation of an ongoing effort.

19. Improved Rock Duster

Objective: To design and fabricate a trickle rock duster whose mass output can be controlled and varied. This is a new RFP.

Methane Control

Program Objectives: To prevent the formation of flammable methane-air mixtures in underground workings through improved ventilation and to develop procedures for degasifying the coalbed in advance of and during mining. To establish correlations between the geology of the coalbed and its gas content and use these to predict methane emission hazards.

Control During Mining

1. Demonstration of Spray Fan in a Very Gassy Mine

Objective: To demonstrate the methane dilution properties of the Spray Fan system in a mine that has high methane emissions. The Spray Fan is to be installed on a mining machine, and the methane concentrations will be compared with the system formerly in use. This is a new RFP.

2. Select and Test Under-Head Locations for Spray Fan Nozzles

Objective: To establish the optimum locations on the cutting head of a continuous miner for mounting Spray Fan nozzles. Nozzle placements will be assessed in terms of their air moving ability, which correlates to their methane dilution ability, and in terms of their in-mine durability. Aboveground tests involve building a model of the front end of a mining machine, and in-mine tests involve the cooperation of a mine company. This is a new RFP.

3. Procurement of Electronic Borehole Surveying Units

Objective: To competitively procure four electronic borehole surveying units for test and evaluation. The electronic surveying instrument aids in maintaining precise control during horizontal drilling, reduces survey time, and permits routine drilling to lengths of 2,000 to 3,000 feet. The instruments will be tested and evaluated for reliability under a wide variety of drilling conditions. This is an IFB.

4. Cost-Effectiveness of Methods for Increasing Air Flow

Objective: To determine the most cost-effective method of increasing airflow in underground mines by considering reducing all factors which cause leakage throughout the mine-air circuit and by changing fans. Efforts will involve ventilation surveys of three underground coal mines, computer simulation study, and determining the optimum choice of leaking stoppings to be sealed and methods to seal them. This is a new RFP.

5. Reducing Leakage Across Line and Check Curtains

Objective: To evaluate present face ventilation practices to improve their effectiveness, and to develop an airtight brattice. The effort involves a survey of present face ventilation practices and measurement of face ventilation air leakages to develop methods to improve the ventilation systems. The effort also involves the development and test of an airtight brattice. The cooperation of at least one coal mine is necessary. This is a new RFP.

6. Improved Extensible Line Brattice

Objective: To survey present extensible line brattice systems, assess problems associated with the systems, and develop an improved system. The improved system will be tested in an underground coal mine. This is a new RFP.

7. Heat Pulse Anemometers

Objective: To provide industry with a self-contained heat pulse anemometer capable of accurately determining low air flows (above 20 feet per minute capability). The field test of 10 to 20 heat pulse anemometers is required. This is a continuation of an ongoing effort.

Ground Control

Program Objective: To conceive, develop, demonstrate, and transfer technology that will prevent mine accidents attributable to falls of ground, outbursts, and slope failures.

Premining Investigations

1. Catalog of Linears in Mining Areas

Objective: To initiate a program to identify and map the geologic trends that are depicted as "linears" on aerial photographs and/or satellite imagery of active and prospective mining areas. The linears that indicate the presence of structural features such as faults, folds, buried river channels, and fractured zones, will be cataloged and used to predict potential ground control problems in the mining areas. This is a new RFP.

2. Detection of Inundation Hazards by Overwater Seismic Methods

Objective: To develop and demonstrate an overwater seismic technique capable of delineating underlying geologic discontinuities, which may constitute a potentially hazardous zone of structural weakness to permit water inrush into nearby underground coal mines. Field tests will be conducted at Rend Lake, Ill. This is a continuation of an ongoing effort.

3. Detection of Mine Hazards Using Electromagnetic Seismic Probing From Boreholes

Objective: To investigate and evaluate relevant cross-hole geophysical techniques, followed by selection, development, and testing of one of them for coal measure rocks. This is a new contract under negotiation.

4. Deep-Penetrating Borehole Geophysical Techniques

Objective: To develop a borehole geophysical technique to remotely sense and locate geologic features that are indicators of potentially hazardous zones or obstacles to future mine development. Work shall continue on development of a prototype borehole radar probe system to detect hazardous features remote from the borehole. This is a continuation of an ongoing effort.

5. Development of Integrated Geophysics for Mining Problems

Objective: To develop the potential effectiveness of integrated geophysical techniques for solving ground control problems in mining. Evaluate the data of seismic, gravity, earth resistivity, and audio magneto telluric measurements available from previous field test; conduct additional tests; investigate the interdependency of various geophysical parameters; and derive new solutions for defining previously undefinable lithologic changes, small faults, and abandoned workings, etc. This is a new RFP.

6. Improved Subsurface Control Data for High Resolution Seismic and Acoustic Techniques

Objective: To improve the reliability of geological interpretation

of high resolution geophysical data by: (1) establishing the relationship between down-the-hole sonic and seismic measurements and surface acoustic surveys, (2) applying the theoretical principles of seismic data inverstion to optimize the interpretation process, and (3) demonstrating the application of resultant data processing techniques. This is a new RFP.

7. Application of In Situ Acoustic Techniques

Objective: To determine the relationship between acoustic wave velocities and in situ stresses in coal pillars by field measurements at selected mine sites. The results will be useful to coal mine pillar design. This is a new RFP.

8. Integral Sampling Instrumentation for Assessing Discontinuities in Rock Masses

Objective: To develop and test an apparatus and instrumentation for obtaining integral samples of rock masses, which will provide information on the occurrence and orientation of joints, faults, and other geologic discontinuities for mine design purposes. The sampling apparatus will be designed, fabricated, and tested at the laboratory and selected mine sites to evaluate its performance and applicability. This is a new RFP.

9. Combined Reflection/Through Transmission Acoustic Cross-Borehole Logging Tool

Objective: To develop and test an acoustic cross-borehole logging tool, combining the best features of both reflection and through-transmission systems, for detection of geologic hazards and delineation of fracture zones. The system will have an emitter probe in a borehole to sent out acoustic pulses to a receiver probe in another borehole at a distance up to 1,000 feet. Geological hazards and other discontinuities located between the boreholes will be delineated of fracture zones. The system will have an emitter probe in a borehole to send out acoustic pulses to a receiver probe in another borehole at a distance up to 1,000 feet. Geological hazards and other discontinuities located between the boreholes will be delineated by transmitted and reflected energies in the received waveforms, and computerized signal enhancement and graphics will be used to assist in data interpretation. This is a new RFP.

10. Determine Validity of Existing Blasting Proximity Criteria and Vibration Scaling Law

Objective: To design and conduct field tests at selected mine sites to measure parameters that can be used to determine the validity of existing blasting proximity criteria and vibration scaling laws for establishing safe distances between surface blasting operations and underground coal mines. This field work is to supplement ongoing, in-house research in establishing blasting proximity guidelines for prevention against damage to underground mines. This is a new RFP.

Selection of Mining Systems and Mine Opening Design

11. Mine Design Related to Stability of Mountain Slopes Undercut by Coal Mines

Objective: To investigate the causes and types of landslides that are induced by coal mines which undercut mountain slopes, derive suitable

procedures for analysis of mountain slope stability, and develop adequate methods for designing a barrier pillar along the outcrop to reduce the risks of slope failure. This is a new RFP.

12. Stress Control Technique for Entry Design

Objective: To investigate the feasibility of using the recently developed stress control techniques as an alternative to roof bolting in underground coal mines. This project shall include computer modeling of mine entry configurations and field demonstration of stress control techniques in development of a deep, longwall coal mine. This is a new RFP.

13. Evaluation and Demonstration of Underhand Stoping to Control Rock Burst

Objective: To develop an inherently safe, underhand stoping method to replace the overhand cut-and-fill stoping method of metal mining in areas prone to rock burst hazards. The contractor shall assist the Bureau in-house project personnel in conducting an in-mine demonstration of the underhand stoping method. This is a continuation of an ongoing effort.

14. Application of Tunnel Support Design Criteria to Metal Mines

Objective: To apply the geomechanics classification system developed for determination of tunnel support requirements to establishing guidelines for metal mine ground support. The guidelines would assist mine operators in determining their ground support need based on rock cores and other geomechanical information obtainable from individual mines. This is a new RFP.

Roof Support Systems

15. Determination of the Optimum Roof Bolt Tension

Objective: To determine the optimum installation tension of mechanical roof bolts for effective roof ocntrol in underground coal mines. The program plan has been developed under a completed contract. It consists of field, analytical, and laboratory studies. This is a new RFP.

16. Stabilizing Ground Conditions Prior to Mining Longwall Panels

Objective: To provide stable roof conditions through the injection of chemicals. Results will be quantitatively verified with stress and strain data. This is a new RFP.

17. Develop and Demonstrate Methods of Supporting High Coal Ribs and Pillars

Objective: To investigate support problems unique to coal seams in the 8- to 20-foot range, and design and test solutions. This is a new RFP.

18. Full-Scale Model Roof Bolt Test System

Objective: To complete trial run and debugging of the full-scale roof bolt test facility that has been constructed at Spokane Research Center, Spokane, Wash. This is a continuation of an ongoing effort.

19. Component Tests of Roof Bolt System

Objective: To conduct laboratory testing of roof bolt performance on full-scale and reduced-scale models of simple concrete beams. The test data will be used as an input to the in-house research project, "Modeling Roof Bolting System." This is a continuation of an ongoing effort.

20. Mine Roof Presupport Field Test

Objective: To develop the state-of-the-art in mine roof presupport using forepoling, and to design a forepoling system suitable for trial in domestic underground coal mines. This project shall include a literature search, mine visits, computer analysis of various forepoling plans and roof reinforcement mechanisms, and preparation of detailed drawings and specifications for the required equipment. This is a new RFP for detailed design, fabrication, and test.

21. Flexible Liner for Use in an Advancing Tailgate

Objective: To design and demonstrate in a selected coal mine a flexible liner and backpacking system for ground support in an advancing tailgate of a newly developed layout of longwall retreat mining. The flexible liner will facilitate maintaining the tail entry, protect miners from roof falls, and provide an adequate ventilation system and fireproof escapeway. This is a continuation of an ongoing effort.

22. Fabrication and Testing of a Low Coal Longer-Than-Seam-Height Drill

Objective: To combine longer-than-seam-height drills with water jet cutting technology, obtain high speed, small-diameter roof bolt holes, regardless of strata. This is a new RFP.

23. Backpacking of Continuously Lined Ground Support Systems

Objective: To define and demonstrate on optimum backpacking method for continuous liners. The study will include both laboratory and in-mine tests. This is a new RFP.

24. Evaluation of Split Set Bolts

Objective: To evaluate the effectiveness of the split set, and

develop a tool for in-mine evaluation of the installed split-set. This is a new RFP.

Safe Support Installation and Protection at the Face

25. Temporary Face Support System

Objective: To build a mobile, temporary roof support unit for use at the working face to insure safety in both continuous and conventional mining. The prototype unit to be built and field-tested is a carrier-and-emplacer unit that can place post-and-beam sets into the freshly excavated face area to support the mine roof temporarily until permanent roof bolting is done. This is a continuation of an ongoing effort.

26. Retreat Mining Support System

Objective: To demonstrate a mobile temporary roof support system consisting of a mobile roof support unit and a temporary breaker prop unit for use in typical room-and-pillar retreat mining. During this fiscal year field demonstration of the system shall be conducted at a coal mine. This is a continuation of an ongoing effort.

27. Evaluation of Roof Bolter Components

Objective: To complete the design, fabrication, and test of a new bolting machine based on the new concepts that are being developed under ongoing research. The new bolter will offer significant advantages over currently available bolting machines, and shall be designed for a specific set of mining conditions. This is a continuation of an ongoing effort.

28. Fabricate and Test a Remotely Controlled, High-Roof Bolting Machine for High-Roof Areas in Coal Mines

Objective: To build and field-test a prototype unit of the remotely controlled, high-roof bolting machine being designed under an ongoing contract. The machine will perform the functions of roof scaling, bolt-hole drilling, and bolt installation with the operator located in a protected location. This is a new RFP.

29. Design and Develop Standardized Controls on New Roof Bolting Machines

Objective: To design, develop, fabricate, and field-test a prototype of a standardized, simplified control system for all types of new roof bolting machines. The standardized control system should reduce potential hazards to bolting machine operators and increase productivity of roof bolting operations. This is a new RFP.

30. Development of a Pumpable Roof Bolt Machine

Objective: To modify the pumpable roof bolt placement machine assembled under a previous research contract and demonstrate the pumpable bolt

system in a selected coal mine using the improved placement machine and a new bolt-resin mix that is being formulated under current in-house and contract research efforts. The improvements shall include new pumping system, capability to handle glass-reinforced polyester core, flexible shaft drill, capability to drill smaller holes, simplified resin handling, and reduced maintenance. This is a new RFP.

31. Improved Installation Equipment and Practices for Roof Trusses

Objective: To design, fabricate, and field-test an improved roof bolting machine that will enable efficient and safe installation of rod-type roof trusses in underground coal mines. This is a continuation of an ongoing effort.

32. Construct and Test a Device for Installing Cement-Grouted Roof Bolts

Objective: To construct a permissible device mounted on a roof bolting machine to enable mixing and placing of inorganic cement grouts into the drill hole before insertion of the bolt, based on the technical information obtained from the Bureau's in-house research project. The device must be small and powered by the hydraulic system of the bolting machine. It shall be tested in the laboratory and in a selected coal mine. This is a continuation of an ongoing effort.

33. Hydro-Mechanical Roof Splitter

Objective: To develop a mechanical means to systematically break down massive roof so as to reduce the risks of roof falls and inherent hazards in the longwall operation. This is a new RFP.

34. Develop a Mechanical Scaling Bar

Objective: To develop a hand-held, lightweight, mechanical scaling bar that will provide a safer, more effective, and less strenuous means of scaling mine roofs. This is a continuation of an ongoing effort.

35. Develop a Mechanized Scaler

Objective: To develop a vehicle-mounted scaler for use in metal/nonmetal mines that allows operation from a safe location. This is a new RFP.

36. Remote Drilling and Bolting System for Metal and Nonmetal Mining

Objective: To design, build, and field-test a remotely operated drilling and bolting system suitable for use in metal and nonmetal mines. The recent advances in rock bolting technology and bolting machine design made under the coal mine safety research program shall be used in designing the new system to meet the specific bolting requirements and mining conditions of metal and nonmetal mines. This is a continuation of an ongoing effort.

37. Rock Bolt Tension-Torque Indicator for Metal and Nonmetal Mines

Objective: To develop an accurate readout and control for tensioning mechanical rock bolts in metal/nonmetal mines. This is a new RFP.

Hazard Detection and Monitoring Systems

38. Commercial Prototype Microseismic Roof Fall Warning System

Objective: To further develop and field test the commercial prototype of the automatic microseismic roof fall warning system that has been developed by the Bureau's in-house and contract efforts. A performance base using natural small-scale roof falls as an input will be established for the prototype. This is a new RFP.

39. Development and Trials of a Prototype Resistivity Roof Fall Warning System

Objective: To develop the prototype unit of a commercially practical, resistivity roof fall warning system based on the results of an ongoing field experiment. The prototype unit will be tested for its practicability and reliability in selected coal mines. This is a new RFP.

40. Accurate Method in Testing Roof--Sounding Bar

Objective: To develop a simplified, portable device for testing roof in coal mines, which will not be affected by variations in seam thickness, roof conditions, or roof composition. This is a new RFP.

41. Fabricate and Demonstrate Best Student-Designed Roof-Failure Indicators

Objective: To encourage students' interest and participation in coal mine safety research, this project is specifically aimed at providing funds to selected universities for fabrication and testing of mine roof failure monitoring devices that will be designed by students in their engineering design courses. The universities shall provide adequate instructions to the participating students and bear all necessary costs for the design phase. This is a new RFP.

42. Modification and Demonstration of the Magnetostrictive Extensometer for Roof-Hazard Detection

Objective: To modify a magnetostrictive roof sag indicator that has been developed under a completed contract to enable continuous assessment of the magnitude, velocity, and acceleration of the relative displacements between a set of measuring points in mine roof and, detection of impending roof falls. This is a new RFP.

43. Application of a Controlled Source Audiomagneto Telluric Field Measuring System to Mining Problems

Objective: To field test and evaluate the controlled source audiomagneto telluric measuring system owned by the Bureau in a variety of mining environments that are known to contain various types of hazards, such as air-filled voids, water-filled voids, karst topography, faults, and abandoned mines. This is a new RFP.

44. Geophysical Hazard Detection From the Working Face

Objective: To develop an operational system using geophysical techniques to delineate abandoned mine workings, water-filled zones, and gas or oil wells from the working face of an operating coal mine. The system parameters and component parts shall be designed and specified based on the results of previous studies. This is a continuation of an ongoing effort.

45. Detection of Abandoned Workings and Cased and Uncased Oil Wells From Microwave Measurements at the Working Face

Objective: To improve previously developed radar sounding techniques and equipment for detection of abandoned workings and cased and uncased oil wells from the working face of an operating coal mine. More field measurements shall be conducted at selected test mines for improvements in instrumentation and data enhancement. This is a continuation of an ongoing effort.

46. Determine Feasibility of Using Machine Vibration Signals as a Seismic Source to Detect Hazards in Advance of Excavation

Objective: To conduct a feasibility study of using mining machine vibrations as a seismic source to detect geologic hazards in advance of excavation. The vibration waves introduced into the coal seam and surrounding rocks by various types of mining machines, and their changes in wave form due to the presence of hazardous geologic structures, will be characterized; and techniques and equipment will be developed for monitoring the vibration waves by placing the receivers at the working face, or in remote boreholes, or on the surface. This is a new RFP.

47. Microseismic Handbook

Objective: To develop a handbook for use by mine operators in selection, installation, and use of microseismic rock burst monitoring equipment, and in processing and interpretation of the microseismic data. This handbook should be comprehensive enough to provide a layman with a good start in developing a sound microseismic hazard detection and analysis network for his mine. This is a new RFP.

Mining and Minerals Processing Waste Stability

48. Develop Conceptual Designs of Dewatering Systems

Objective: To conduct large-scale field tests of coal waste dewatering systems that will be tested and evaluated at the laboratory under a prior contract research effort. Designs will be developed, based on the test results, to integrate the dewatering systems into normal operations of coal preparation plants. This is a new RFP.

49. Mixing Coarse/Fine Coal Waste

Objective: To develop a low-cost method of mixing fine and coarse coal waste in order to minimize segregration and layering of waste embankments. This work will include: investigation of various operations in constructing coal waste embankments; drilling and sampling of waste embankments to determine if segregration and layering of their component materials is indeed happening, and the resulting effects on embankment stability; and development of a mixing method to avoid the detrimental effects of particle segregration and layering. This is a new RFP.

50. Embankment Deterioration Versus Time

Objective: To determine coal waste embankment contruction techniques that will minimize deterioration of embankment materials with time, and to develop a cost-effective method of restoring or modifying old, existing coal waste embankments to improve their structural integrity and safety conditions. This is a new RFP.

51. Feasibility/Demonstration of Risk Analysis Applied to Tailings Embankments

Objective: To demonstrate the feasibility of applying risk analysis techniques to minerals processing tailings embankments by conducting risk analysis of three typical but contrasting cases. The test cases include a well-defined, large-scale embankment at a high production mine, an embankment lcoated in a high-risk (heavily populated) area, and an isolated embankment from a sparsely populated area. Critical parameters, such as the slope ratio, quality of packing and compaction, and drainage requirements, will be defined to demonstrate cost effects on the risks involved. As to risks, the value to be placed on potential losses of property and life will be assessed. This is a new RFP.

Industrial Hazards

Program Objectives: To (1) limit the possibility of human error through training and worker-machine interfacing, (2) improve equipment design and controls, (3) detect and prevent failures of electric circuitry and hardware, (4) provide adequate lighting in working areas, (5) insure

continuous and reliable communication between all underground and surface mine personnel, while providing continuous surveillance of the mine environment, and (6) improve safety in haulage and materials-handling operations.

Human Factors

1. Haulage Truck Training System

Objective: To continue with the design, development, and implementation of a haulage truck training system that would satisfy the training requirements of haulage truck operators. This project will design and develop the hardware and software necessary to implement the training system. This is the continuation of an ongoing effort.

2. Development of a Front-End Loader Training System

Objective: To design, develop, validate, and implement a front-end loader training system that would satisfy the training requirements of front-end loader operators. This phase of the program will design and develop the hardware and software necessary to implement the training system. This is the continuation of an ongoing effort.

3. Improvement of on-the-Job Training Procedures Through Utilization of Modeling, Initiative, and Other Learning Techniques

Objective: To reduce accident behavior by improving the initial entry learning situation through the utilization of modeling, initiative, and other learning techniques. The project will consist of providing expert models for miners who are acquiring new work tasks. These models will serve as discriminative stimuli for various task elements and will provide error-free examples for initiative learning. This is the continuation of an ongoing effort.

4. Investigation and Development of Training Programs for Shaft Sinking Personnel

Objective: To develop, implement, and validate training programs for shaft sinking personnel. A program of instruction and training strategy will be devised. This is the continuation of an ongoing effort.

5. Visibility Requirements for Face and Mobile Underground Coal Mining Equipment

Objective: To generate visual data that is necessary and desirable to have while operating face and mobile underground mining equipment, to provide data which would serve design engineers in making decisions as to work station design and location, and to provide data which would

define high risk areas in terms of limited or constricted fields of vision. This is a new RFP.

6. Study to Determine The Feasibility of Utilizing Employee Assistant Programs in the Mining Industry

Objective: To explore the feasibility of utilizing employee assistance programs to reduce accidents associated with employee personal problems. This project will attempt to acquaint the mining industry with the concepts and procedures of reducing injuries and accidents through utilization of joint management-labor employee assistance programs. An attempt will be made to conduct a demonstration project within one or more companies. This is a new RFP.

7. Cross-Validation of Mining Population Against Known Anthropometric Data

Objective: To cross validate the anthropometric dimensions of a select sample of the mining population against known data, such as that used by the military. This project will entail selecting a representative sample and making limited anthropometric measurements, which will then be cross validated against accepted data from other sources. This is a new RFP.

8. Development of Training for Blasters

Objective: To develop a training program for blasters. Based on information obtained from a previous contract, training courses will be put together in modular form so that individual training needs of blasters can be met. This is a new RFP.

9. Evaluation of Delivery Systems for Effective Training

Objective: To determine if the selection and use of the proper choice of delivery systems can improve the quality of training, increase trainee motivation, and improve learning rates. The proposal effort will serve to investigate various types of training material as presented on select types of training media. This is a new RFP.

10. Development of Materials and Strategies for Normal and Emergency Operations of Surface Mining Equipment

Objective: To design, develop, validate, and implement model specific training programs for emergency as well as normal operation of equipment used in surface mining operations. This is a new RFP.

11. Design and Evaluation of Human Engineered Work Stations for Surface and Underground Equipment

Objective: To provide the resources for technical assistance to the Human Factors Working Committee concerning concept development, preparation of work-station layout drawings, and mockup fabrication for evaluating the human factors guidelines recommended for the equipment. Based on human factors guidelines from the committee, work station concepts will

be developed and followed by detailed work station layout drawings. The most feasible designs will be evaluated through fabrications and demonstration of full-scale mockups. This is a new RFP.

12. Evaluation and Comparison of Linear and Branching Delivery Systems

Objective: To evaluate and compare linear programing format and branching programing format, and to develop strategies and materials for certifying personnel. The program will evaluate two media strategies for training effectiveness, develop branching program materials and determine and develop partial electrician certification requirements. This is the continuation of an ongoing effort.

13. Biomechanical Study of Work in Underground Noncoal

Objective: To conduct a biomechanical study of work in underground noncoal with the intent of generating data that can be utilized in optimal job work station design. Strength and work capacity measurements of miners will be taken and correlated with physical demands of various job tasks. Recommendations for task and job redesign will be made.

14. Training Programs for Sand and Gravel

Objective: To develop the training programs for the sand and gravel industry to satisfy the training requirements. This project will design and develop the hardware and software necessary to implement training systems for the sand and gravel industry. This is a new RFP.

Electrical

15. Development of Tests and Criteria To Evaluate Grounding Systems

Objective: To evaluate mine grounding systems, optimize ground bed construction, develop analytical techniques, evaluate grounding components and develop shock prevention instrumentation. Development of optimal methods of ground bed construction will be continued along with the evaluation of components used in construction. Emphasis will be placed on surface mine grounding systems. Recommendations for DC grounding and electric shock prevention will be finalized. This is a continuation of an ongoing effort.

16. In Mine Demonstration of Discriminating Circuit Breaker System

Objective: To demonstrate the discriminating circuit breaker system in a coal mine. The demonstration will check the effectiveness of the fault detection system under mining conditions. This is a continuation of an ongoing effort.

17. Mine Trailing Cables and Cable Splices

Objective: To improve the safety of electrical cables by conducting

laboratory and field studies on methods of handling, repairing, and using cables. Cable and splice materials and construction will be evaluated for possible improvements. Flexibility, life flexure, high temperature performance, etc., of cables used on shuttle car reels will be investigated. This is a continuation of an ongoing effort.

18. Analysis of Explosion-Proof Enclosures

Objective: To develop performance requirements for permissible enclosures that provide, at a minimum, the same degree of safety as the existing requirements. A design guide is being developed based on the new performance requirements. This is a continuation of an ongoing effort.

19. Application Notes on Mine Electric Power Systems

Objective: To prepare application notes based on Bureau of Mines research on electric power system devices and methods. Notes will be prepared in a standard format, through in-depth interviews with Bureau principal investigators, study of final reports, etc. The notes will be disseminated to industry maintenance and operating engineers. This is a continuation of an ongoing effort.

20. Recommended Acceptance Testing Criteria for Epoxies, Cements, Adhesives, and Similar Materials for Explosion-Proof Electrical Enclosures

Objective: To develop requirements for sealants, cements, or adhesives used in constructing explosion-proof electrical enclosures. Efforts relating to quality assurance of these materials when used in the enclosures is being expanded. Guidelines for the acceptance testing criteria of these materials are being developed. This is a continuation of an ongoing effort.

21. Evaluation of Proximity Warning Devices

Objective: To evaluate the commercially available proximity warning devices. If none are found reliable, which appears to be the case, a new prototype shall be designed, fabricated, and tested under mining conditions to demonstrate its reliability. This is a continuation of an ongoing effort.

22. Explosion-Proof High and Medium Voltage Connectors for Inline and Machine-Mounted Use With Underground Coal Mine Drag Cables

Objective: To design, fabricate, and in-mine demonstrate an electrical connector that is explosion-proof and can be used with high and medium voltages in underground mining. This phase of the project will cover the fabrication of the selected connector design. In-mine testing will follow. This is a continuation of an ongoing effort.

23. Innovative Techniques in Trolley Line Power Distribution

Objective: To evaluate various approaches to reduce the possibilities of personnel injury and ignition of combustible materials by underground trolley wires. This phase will be a demonstration of the hardware developed during the conceptual phase consisting of factory insulated trolley wire, a visual indicator of excessive insulator temperature rise, rapid inspection of insulators, and a dual-trolley system concept. This is a continuation of an ongoing effort.

24. Environmental Test Criteria for the Acceptability of Mine Instrumentation

Objective: To develop criteria for the purpose of testing the suitability of electrical instruments and apparatus for mining environments as related to dust, shock, vibration, humidity, temperature, and other tests. Findings will be consolidated into a format which can be used to assure that mine instrumentation will operate safely in mining environments. This is a continuation of an ongoing effort.

25. Recommended Acceptance Criteria for Potting Materials Used in Explosion-Proof Enclosures

Objective: To develop an acceptance guideline (including test methodology, failure criteria, permissible quantity) for potting materials based on arc decomposition products. This relates to the flammability and explosivity of the products formed when the potting material is decomposed by an electric arc when the electrical equipment it is protecting fails during service. This is a continuation of an ongoing effort.

26. Trolley Line Power Transfer to Vehicles

Objective: To develop a safer mechanism for the transfer of power from the trolley line to vehicle. Project will include testing of new trolley pole and examination of shoe for improvements. This is a continuation of an ongoing effort.

27. Modification of a Fail Safe Trolley Wire Energizing/Deenergizing System

Objective: To demonstrate the fail safe trolley wire energizing/deenergizing system in an operating mine. The demonstration will check the effectiveness of this system under actual mining conditions. This is a continuation of an ongoing effort.

28. Feasibility of Cable Breakage Protection

Objective: To determine the feasibility of providing protection from cable breakage on mine equipment when the cable is exposed to high stresses. This occurs when the cable hits the end of the reel or when the cable becomes caught. Quick-release connectors and other techniques will be examined. This is a new RFP.

29. Evaluation of Cable Fault Locating Devices

Objective: To evaluate cable fault locators based on laboratory and field tests. Field tests will include usage under actual mining conditions. This is a new RFP.

30. Development of a Connector for Low-Voltage Shielded Cables

Objective: To develop a permissible connector for use with low-voltage, high-current shielded cables that are used in control circuits and lighting systems. This is a new RFP.

31. Cable Usage and Splicing Techniques

Objective: To develop, fabricate, and test prototype splicing tools and to perfect techniques indicated as necessary for splicing of mine electrical cables. This is a new RFP.

32. Field Demonstration of Innovative Enclosure Hardware

Objective: To demonstrate innovative explosion-proof enclosure hardware developed under previous Bureau of Mines contract. This will include a 6- to 10-month field evaluation. This is a new RFP.

33. Feasibility of New Explosion-Protection Techniques

Objective: To evaluate alternate or new techniques used for explosion protection in electrical enclosures. This will include pressurized enclosures, sand field enclosures, etc. This is a new RFP.

34. Evaluation of Ground Fault Detectors

Objective: To evaluate new or alternate ground fault detectors that incorporate high sensitivity. This will include items utilized in other countries that provide protection superior to that commonly employed in the United States. This is a new RFP.

35. Improvements in Trolley Wire Hardware

Objective: To fabricate innovative hardware for trolley wire lines that were developed or designed under previous Bureau of Mines contracts. This is a new RFP.

36. Recommend Practices for Electric Shock Protection in Control Circuits

Objective: To develop recommended practices to prevent electric shock during repair or maintenance of control circuits. This project will explore the use of test points and other means to protect the maintenance personnel from high voltage during "trouble shooting" of the faulty system. This is a new RFP.

37. Electrical Practices in Metal/Nonmetal Mines

Objective: To identify practices currently used in metal/

nonmetal mine electric power distribution systems and establish the relationship between proper treatment of hazards encountered and the applicable MSHA regulations. Safe practices will be identified, as well as problems that will need further study. This is the continuation of an ongoing effort.

38. Recommended Grounding Practices for Metal/Nonmetal Mines

Objectives: To quantitatively evaluate the contribution to safety of ground wire monitors when applied in metal/nonmetal mine electrical systems. This is the continuation of an ongoing effort.

39. Electrical Safety Improvements in Haulage and Distribution Systems

Objective: To identify the more important safety problems in haulage and distribution systems used in metal/nonmetal mines and recommend research leading to solution of these problems. This is a new RFP.

Equipment

40. Development and Assessment of New and Existing Canopy Technology to Lower Coal Seams

Objective: To provide equipment operators with protection from fall of roof and rib in thin seams and a human engineered work stations. This phase of the program will include development of detailed designs, fabrication, and field demonstrations of the concepts and mockups developed in phase I of the program. This is a continuation if an ongoing effort.

41. Improved Visibility Systems for Large Haulage Vehicles

Objective: Evaluate, by means of long-term, on vehicle testing, the reliability and cost-effectiveness of improved components of the improved truck driver visibility system on other classes of vehicles, such as front-end loaders and shovels. This is a continuation of an ongoing effort.

42. Development of ROPS Performance Criteria for Large Mining Equipment

Objective: To provide data on large machines ROPS performance criteria by actual rollover tests of two large machines to determine if present criteria are adequate. Three ROPS for each of two large front-end loaders will be used in the test program. The data from the tests will be used to verify existing performance criteria or develop new criteria. This is a continuation of an ongoing effort.

43. Improved Ingress/Egress Systems for Large Front-End Loaders, Large Tracked Dozers, and Loading Shovels

Objective: To evaluate the safety hazards related to ladders on large front-end loaders, large tracked dozers, and loading shovels. New designs will then be developed and demonstrated through in-mine testing. This is a continuation of an ongoing effort.

44. Radar-Transponder Anticollision Systems for Large Mine Haulage Trucks

Objective: To explore the use of radar-transponder technology in preventing the collision of large surface vehicles. Work shall include long-term, in-mine testing of the low-cost anticollision system developed previously in the program. This is the continuation of an ongoing effort.

45. A Study to Determine the Feasibility of Providing Adequate Human Engineered Operator's Cabs in Thin Seams Through the Use of a Remotely Positioned Operator

Objective: To determine the feasibility of using a remote control miner system as an alternative to canopies in low coal seams. The effort will be to design, build, and demonstrate a prototype or retrofit system in an active mine. This is the continuation of an ongoing effort.

46. Design and Development of a Variable-Response Hydraulic Control Valve

Objective: To examine and change as required a manual hydraulic tram control that will enable a mine machine operator to tram without inducing dangerous lurching. The redesigned control will then be demonstrated in a field demonstration under actual mining conditions. The control would be used for retrofit as well as in new equipment designs. This is a new RFP.

47. Surface Equipment Modification for Increased Safety

Objective: To modify methods, operating procedures, and/or equipment used in mines identified as a result of previous studies. This effort will be aimed at investigating specific problems contributing to unsafe conditions attributable to equipment or machinery usage in surface operations. This is a new RFP.

48. Extension of Low Coal Canopy Technology to Include Coal Drill and Cutting Machine

Objective: To design, fabricate, install, and test protective canopies for use in 42-inch or lower coal seams for a coal drill and cutting machine. These canopies will be demonstrated in an active mine. Selection of machines to be used in this program will be based on the number currently used in mining and the most likely to accept a retrofit canopy. This is a new RFP.

49. Underground Equipment Modifications for Increased Safety

Objective: To evaluate existing underground mining systems for unsafe or problem equipment and machinery in phase I and recommend corrective action in phase II. This effort will be directed at specific conditions, with recommendations as to methods, procedures, and equipment that will correct these problems. This is a new RFP.

50. Fire-Resistant Fluid Compatibility and Limitations

Objective: To determine any safety limitations of fire-resistant fluid as related to hydraulic system components on mining equipment. Drastic changes in hydraulic component life could result in lack of vehicle control, excessive maintenance related injuries, or other safety problems. This is a new RFP.

51. Development of Pressurized Boom Inspection System

Objective: To develop a visual inspection leak system for pressurized booms on draglines. This will reduce the danger associated with inspection of dragline booms where maintenance personnel are required to crawl over the elevated booms to detect cracks. This is a new RFP.

52. Driver Alertness Monitoring Systems for Large Haulage Vehicles

Objective: To develop, demonstrate, and test reasonable-priced, reliable driver alertness monitoring systems for large, open-pit haulage vehicles. This year's work will evaluate the effectiveness of the newly-developed alertness devices through in-mine testing. This is a continuation of an ongoing effort.

53. Technical Guidelines for the Determination and Evaluation of ROPS Vibration/Fatigue Failure

Objective: To establish technical guidelines for the determination and evaluation of the effects of vibrations on the structural members of the ROPS. This is a USP.

Illumination

54. Illumination of Specialized Mining Equipment

Objective: To provide assistance to MSHA and the industry in the illumination of particularly difficult mining machines. These machines, such as low coal LHD's are typically specialized machines that are not widely utilized but must be illuminated. This is a new RFP.

55. Factory Integration of Illuminating Systems Into Mining Machinery

Objective: To redesign presently produced conventional or continuous-type mining machines with integral illumination systems. This is a new RFP.

56. Innovative Illumination Hardware for Underground Coal Mines

Objective: To investigate and develop component hardware that will address itself to the problems of reliability of present retrofit lighting components and overall human engineering aspects of underground coal mine illumination systems. This is a new RFP.

57. Illumination of Surface Mining Equipment

Objective: Design illuminations systems to meet the requirements of the proposed surface illumination regulations. This system will then be implemented during in-mine demonstrations. This is a new RFP.

58. Investigations of Special Problem Areas Associated With the Illumination of Surface Mining Equipment

Objective: To design and implement the specialized power supplies needed to illuminate these machines and to adapt existing luminaires, where necessary. This is a new RFP.

59. Maintenance of Lighting Systems on Underground Mining Equipment

Objective: To (1) obtain information on cost and downtime on the maintenance of underground lighting systems, (2) develop and recommend procedures to reduce these costs and minimize downtime, and (3) transfer technology to industry through the use of seminars and final report (maintenance manual). This is a new RFP.

60. Evaluation of Illumination Requirements in Metal/Nonmetal Mines

Objective: To define the minimum luminance requirements for various job tasks and work areas in metal and nonmetal underground mines in order to provide overview information and supportive data for the formulation of illumination standards. This is a new RFP.

Nonemergency Communications

61. Communications Equipment and Technology Assistance to MSHA

Objective: To respond to MSHA requests for the development of devices and techniques concerned with communication problem areas. The investigation will involve mine trials and measurements as well as laboratory testing and evaluation. This is a new RFP.

62. Phone Line Attenuation Characterization

Objective: To study existing mine phone lines and characterize them as medium frequency, transmission lines. Work would give experimental data to correlate theoretical work done for the Bureau in the past. This is a new RFP.

63. Build to Specification Selective Pager Phones

Objective: The contractor will build to specifications selectable pager phones. The design will incorporate both the Bureau's specifications and the contractor's latest pager phone electronics and packaging concepts. The contractor will make arrangements with a cooperating coal mine and test the units for 1 year. This is a new RFP.

64. Prepare Handbook on "MF Radio Guidelines"

Objective: To prepare a manuscript from existing information that describes the use, advantages, and disadvantages of MF radio systems and the propagation characterization of each system. This is a new RFP.

65. Demonstration of the Thru-the-Earth Monitoring System

Objective: To test in a mine, a Bureau-developed mine monitoring system that uses the mine phone lines to transfer data and control signals under normal conditions, but can also transmit thru-the-earth when the lines are broken. This is a new RFP.

66. Guidelines for the Selection and Implementation of Mine Communication Systems

Objective: To produce an information document for the mining industry that will detail the process of communication system functional design and general hardware selection. This is a new RFP.

67. High-Speed Telemetry System for Mining Machines

Objective: To develop and evaluate a system that transmits machine parameters (vibration, rpm, etc.) from the machine to a remote receiver by radio means. This is a new RFP.

68. Equipment for Medium Frequency Communications Demonstration

Objective: To procure Medium Frequency equipment to Bureau specifications for use in a communication demonstration program. This is a new RFP.

69. Demonstration of Visual Pager Systems

Objective: To demonstrate Bureau-developed advanced visual pager/control systems for 1 year in a operating mine. This is a new RFP.

70. Fiber Optic Telephones for Intrinsically Safe Communications

Objective: To develop a telephone system that uses fiber optic technology to provide both intrinsically safe electronics and intrinsically safe lines. This is a new RFP.

71. Modification of KDS 960 Data Collection Panel for Specific Use in Mines

Objective: To upgrade and standardize S.R. Smith data collection panels for use in mine environments. This is a new RFP.

72. Rewriting of Reports

Objective: To rewrite the Grace Mine and Robena Mine reports submitted in draft form. This is a new RFP.

73. Multiplex Distrubution System for Multichannel Pager Phone Communications

Objective: To develop a multiplex haulageway distribution system that can take present pager phones and provide a multichannel selective telephone system over a single wire pair. This is a new RFP.

74. Revision of "Underground Mine Communications, Control, and Monitoring" Manual

Objective: To incorporate feedback from the mining industry into the "Underground Mine Communications, Control, and Monitoring" Manual. This is a new RFP.

75. Lucerne Mine Demonstration - Hardware

Objective: To provide UHF communication equipment modified to Bureau specifications. This is a new RFP.

76. Machine-Mounted Environmental Monitoring Station

Objective: Provide a machine-mounted monitoring station that will continuously monitor the environment at or near the working face and transmit the information so obtained to a central station. This is a new RFP.

77. Portable, Wireless, Environmental Monitoring Station

Objective: To provide a portable, battery-operated, environmental monitoring station having wireless telemetry ties to an environmental monitoring system. This is a new RFP.

78. Integrated Pager Phones

Objective: To provide pager phones manufactured to Bureau specification and to test same in an operating mine for 1 year. This is a new RFP.

79. Demonstration Communication System for a Salt Mine

Objective: To implement a mine communications and environmental monitoring system in a multilevel salt dome mine and gain base information for establishing communications and monitoring guidelines and standards. This is a new RFP.

80. Black River Mine Communication System Support

Objective: To support the continuing installation, maintenance, and demonstration of communication, telemetry, and monitoring systems at a representative room and pillar metal/nonmetal mine. Modification to present contract.

81. Sunshine Mine Communication System Support

Objective: To support the continuing installation, maintenance, and demonstration of communication, telemetry, and monitoring systems at a deep hardrock mine. This is a new RFP.

82. Study of a Self-Calibrating Monitoring System

Objective: To investigate alternatives to manual calibration of sensors in an underground mine and to recommend a system that permits calibration to be accomplished automatically from a central location. This is a new RFP.

Haulage and Materials Handling

83. Novel Cab Design Concepts for Large Haulage Vehicles

Objective: To develop and analyze design concepts of novel cabs that will improve operator safety on large haulage vehicles used in surface mines. A potential economic analysis and detailed mechanical design of the conceptual haulage vehicle will be done. This is the continuation of an ongoing effort.

84. Improved Emergency Shutoff-Lockout Systems for Conveyors

Objective: To reduce conveyor related accidents by developing and demonstrating an integrated emergency shutoff/lockout system. Emphasis will be placed on integrating the lockout and emergency shutoff systems such that deenergization of the conveyor belt can be accomplished anywhere along the belt. This is a new RFP.

85. Develop and Demonstrate a Maintenance and Material Handling Vehicle

Objective: To modify a mining vehicle to safely perform general purpose maintenance and handling of bulky materials such as railroad rails, pipes, etc. The vehicle will be demonstrated in an underground coal mine. This is a new RFP.

86. Develop a Safer Method to Clean Out Storage Bins

Objective: To develop a system that eliminates or minimizes the hazard resulting from the cleaning out or breaking up of material bridging in storage bins. This is a new RFP.

87. Evaluation and Development of Locomotive Brake Sanding Systems

Objective: To review, evaluate, and identify problems with wheel sanding systems of rail cars and locomotives. Develop new or existing systems to eliminate the identified problems. This is a new RFP.

88. Safety Evaluation of Conveyor Belt Cleaning Systems

Objective: Reduce the number of accidents during the cleaning of conveyor belts. The project will include evaluation of existing conveyor belt cleaning systems. This is a new RFP.

89. Develop and Demonstrate Shock-Absorbing Extended Bumpers for Large Haulage Vehicles

Objective: Reduce haulage truck collision related fatalities and injuries by developing and testing high-strength extended bumpers for haulage trucks. Project will develop performance criteria for bumpers as well as in-mine test improved designs. This is a new RFP.

90. Develop Safer Methods of Maintaining Underground Conveyors

Objective: To design, fabricate, and test safer methods of maintaining underground conveyor systems. Maintenance operations that can be made safer will be identified. Safety interlocks, redundant circuits and mechanisms, guards, and mechanisms that allow servicing from a safe distance will be investigated. This is a new RFP.

91. Testing Arrestment Devices of Jewel Shaft of Sunshine Mine

Objective: To devise inspection and testing procedures for a small, emergency mine hoist. This is the continuation of an ongoing effort.

92. Nondestructive Testing for Wire Rope Retirement

Objective: To examine and determine the applicability of new non-destructive testing techniques for wire rope retirement. This is a new RFP.

93. Haulroad Berm, Guardrail, and Sign Design Study

Objective: To provide guidelines for the design of berms and protective guardrails for haulage roads. The sizes, shapes, strengths, and material composition of berms will be determined for the different size classes of haulage equipment. This is the continuation of an ongoing effort.

94. Improved Equipment Design or Reduced Haulage Truck Maintenance-Related Injuries

Objective: To reduce injuries resulting from maintenance operations on mine haulage trucks by improving the design of machine components shown to be particularly hazardous to maintain. Factors to be considered may include equipment design, component selection and location, materials of construction, maintenance requirements, costs associated with proposed modifications, and other factors. This is a new RFP.

Post-Disaster

Program Objectives: To develop technology that will (1) enable survivors of a mine disaster to escape from the mine or to continue to survive while awaiting rescue by providing protection against toxic and/or oxygen-deficient atmospheres, (2) aid in the location of miners trapped underground, using seismic and electromagnetic means of communication, and (3) facilitate post-disaster rescue and recovery operations through surface monitoring of conditions underground, emergency communications, and mechanized transport and life support equipment for mine reentry and rescue operations.

Survival

1. Improved Oxygen Sources for Breathing Apparatus

Objective: To attempt a synthesis of pure metal superoxides. Several methods shall be examined, including reaction of metal salts with potassium superoxide, reactions of metal hydroxide, solvent extraction techniques for purification, and electrochemical techniques. Physical and chemical properties (reaction with CO_2 and water, decomposition temperature, etc.) of purified metal superoxides shall be studied. This is a continuation of an ongoing effort.

2. Physiological Responses of Miners

Objective: To quantitatively evaluate (1) the physiologic responses of miners to the demands brought about by emergency conditions, (2) the biophysical interaction between the miner and the prevailing environmental conditions during emergency, and (3) physiologic metabolic responses of rescue team members, including studies of fatigue when working for longer than 2 hours, effect of inhalation of hot air, and effectiveness of cooling garments to relieve heat stress during rescue missions. This is a continuation of an ongoing effort.

3. Breathing Apparatus Person Tests

Objective: To test current breathing apparatus to determine the ability of these devices to meet newly developed person tests prescribed in 30 CFR 11. Tests shall also be performed to determine the effect of positive-pressure breathing apparatus. This is a new RFP.

4. Breathing Simulator

Objective: To develop a new breathing simulator which is more practical to use than the ABMS. The simulator will be designed for use by NIOSH-MSHA for certifying breathing apparatus. This is a new RFP.

5. Compressed O_2 Self-Rescuer

Objective: Contractor will develop a 1-hour compressed oxygen self-rescuer, comparable in size and weight to available O_2 self-rescuers. This is a new RFP.

6. Underground Travel Speeds

Objectives: Determine actual travel speeds and physiological stress in various coal mines of 30 to 72 inches in height. This is a new RFP.

7. Lightweight Oxygen Cylinders

Objective: Contractor will develop a new lightweight O_2 pressure vessel. This is a new RFP.

Communications

8. Mine Personnel Locator for Metal/Nonmetal Mines

Objective: Develop and demonstrate mine personnel locator and in-mine activity controller having multipoint input/output capabilities to provide instantaneous personnel location, communication, emergency warning, hazardous sensing, and emergency maintenance control in one low-cost system. This is a new RFP.

9. Autodetection Algorithm for MSHA's Seismic Location System

Objective: To develop an autodetection algorithm for use with MSHA's seismic location system. The algorithm shall identify potential seismic signals generated by trapped miners by use of advanced data-processing techniques, determine time delays between first-break seismic events, and enter these data automatically into a refined location program. This is a new RFP.

10. Theoretical Investigation of Seismic Waves Generated in Coal Mines

Objective: To study the feasibility of in-mine seismic monitoring, to outline its application in detecting and locating trapped miners, and to determine if inside-mine monitoring has any significant advantages over surface seismic monitoring. Signal detection by in-mine implanted geophones shall be investigated. This is a continuation of an ongoing effort.

11. Phase Quadrature Retransmission System for Locating Trapper Miners

Objective: During FY 79, Polhemus, under Bureau contract, developed a retransmission scheme using phase-quadrature detection to locate a trapped miner. The objective of this new work is to develop hardware to implement this technique and test it in the field. This is a new RFP.

12. Seismic Communications With Trapped Miners

Objective: To provide effective communications with men trapped underground through seismic techniques. This is a new RFP.

Rescue and Mine Reopening

13. Low-Profile Rescue Breathing Apparatus

Objective: Build preproduction units of a 2-hour, low-profile, compressed oxygen rescue breathing apparatus (RBA) that will be suitable for use in low coal and at longwall faces. The RBA's will be available for MSHA evaluation in early FY 81. This is a new RFP.

14. Handbook of Oxygen Breathing Apparatus and Auxiliary Mine Rescue Equipment

Objective: Update the miner's Handbook on Mine Rescue Apparatus and Auxiliary Equipment that was published in 1961. This is a new RFP.

Explosives

Program Objectives: To assess the problems associated with the safe and effective use of explosives in all types of mining activity; these include fixed explosives, blasting agents, blasting devices, and blasting accessories. To conduct fundamental studies of explosive behavior and apply the results in the development of new technology. To develop new and improved test procedures, as new mining methods are introduced and new types of explosives are formulated.

Blasting Agents and Other Hazardous Chemicals

1. Pneumatic Loading of AN-FO in Underground Mines

Objective: To examine current pneumatic loading procedures, evaluate commercially available pneumatic loaders, determine AN-FO loading densities and initiating sensitivities, determine if loaders are properly grounded and make recommendations for loading pressures, initiation methods, and ground procedures. This is a new RFP.

2. Develop an Unloading Device for AN-FO Charged Blastholes

Objective: To develop and field test a vacuum type system for the removal of stemming (drill cuttings) and AN-FO blasting agent from blastholes. This system will reduce safety hazards caused by misfired blastholes and flyrock from overloaded blastholes. This is a new RFP.

3. Improved Drill Setup and Layout of Blasthole Patterns

Objective: To evaluate present drill setup practices and determine what technology is available to reduce setup time and increase drill leveling accuracy, so that vertical blastholes are drilled. Evaluate present practices and develop new methods to improve the speed and accuracy of blasthole pattern layout. This project will reduce flyrock generation due to change in the burden and spacing. This is a new RFP.

4. Blasthole Depth and Stemming Height Measuring Systems

Objective: To evaluate the state-of-the-art of blasthole depth and stemming height measuring systems and recommend areas for further research and development. This project will survey mining industry needs for blasthole depth and stemming height measuring systems. Current methods will be evaluated. Recommendations will be made regarding further research to develop better mechanical methods and also more exotic electronic systems. This is a new RFP.

5. Survey of Electrostatic Hazards Detection and Minimization

Objective: To critically evaluate the magnitude and extent of electrostatic hazards in blasting operations, and the adequacy of techniques, materials, and equipment for detecting and minimizing these hazards. This is a new RFP.

6. Handbook of Explosive Accessories

Objective: To produce a handbook for use by mine blasting personnel that will serve as a guide to the characteristics and proper use of, and, where appropriate, procedures for checking all types of equipment used as accessories in mine blasting operations. This is a new RFP.

7. Guidelines for Fire Protection Systems on Explosive and Blasting Agent Conveyances

Objective: To determine what fire control systems are needed for vehicles carrying explosives and blasting agents, and to provide recommendations for adequate fire control systems on these type vehicles. This is a new RFP.

Systems Engineering

Program Objectives: To develop mathematical models for evaluating the impact of specific technological improvements or inadequacies on the total mining and minerals processing operations and identifying problems whose solution would provide the greatest health and safety benefit. To operate and maintain underground research and test facilities for use in testing and demonstrating new procedures and equipment, before they are field-tested in commercial mines. To participate in contract development and in the formulation of mining and minerals processing health and safety standards.

Systems Analysis

1. Research To Improve Accident Reduction Programs

Objective: To ascertain current efforts utilized by mining operators in reducing industrial type accidents and to develop one or more prototype management systems for improving safety programs. The project will entail a comprehensive research review of existing accident reduction programs throughout the mining industry. The emphasis will be placed on identifying unique program elements that potentially have wide applicability. Recommendations will be made for improving safety programs and the development of one or more prototype safety systems, which mine operators can use as a model to improve safety programs. This is a new RFP.

2. Survey of Equipment in Underground Mines

Objective: To perform a detailed survey to characterize the battery, electrical, and diesel-powered equipment population in underground coal mining operations. To provide a useful source of information to mine planners, and act as a comparative guide to mine operators who are experiencing problems in the use of this equipment or are dissatisfied with present performance. Detailed characteristics statistics, and trends will be compiled to determine priorities for future health and safety research projects. This is a new RFP.

3. Improvement of Nonfatal Mine Accident Reporting System

Objective: To improve, through self-reporting, the reliability and validity of the nonfatal mine accident reporting system. The project will determine the feasibility of utilizing a self-reporting system in assessing the complete chain of events that produce nonfatal mine accidents. The system will consist of a "stand alone" preprogramed terminal with which the injured miner will interact. The system will employ branching technology that will bypass irrelevant information and provide data not made available by HSAC reporting requirements. This is a new RFP.

4. Hazard Analysis of Preparation Plant Operations

Objective: To analyze each preparation plant operation to identify hazardous preventative measures to eliminate conditions. To conduct surveys of preparation plant operations to establish the types of data required for a hazard analysis, a classification of types of equipment used, and the tasks required to operate this equipment. To collect the data necessary to eliminate the hazards. This is a new RFP.

5. Analysis of the Economic Impact of Fatal and Traumatic Injury Accidents in Surface Metal and Nonmetal Mines

Objective: To conduct a feasibility study to determine if fatal and traumatic-injury accidents in surface metal and nonmetal mines can be correlated with production or other economic loss using 1978 cost data. To develop accident cost models for surface metal and nonmetal mines. This is a new RFP.

6. Hazard Analysis of Minerals Processing Plant Operations

Objective: To analyze each preparation plant operation to identify hazardous preventative measures to eliminate conditions. Conduct surveys of preparation plant operations to establish the types of data required for a hazard analysis, a classification of types of equipment used, and the tasks required to operate this equipment. Collect the data necessary to identify operation hazards and develop/recommend preventative measures necessary to eliminate the hazards. This is a new RFP.

Test Facilities

7. Construct Wire Rope Test Laboratory

Objective: To provide a facility capable of supporting the ongoing mining research program on wire rope primarily in hoise rope retirement criteria. Additionally, information will be obtained for wire rope selection, inspection, and termination and lubrication procedures. This is a new RFP.

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